What is claimed is:

1. An energy transfer multiplexer to control the flow of energy through an energy conversion system coupled between an energy source and an energy load comprising a bi-directional inverter including a first plurality of energy transfer control elements and a second plurality of energy transfer control elements operatively coupled by a resonant transfer link to selectively control the direction of energy flow between said first and second plurality of energy transfer control elements to control the operation of the energy conversion system in response to a plurality of predetermined conditions.

2. The energy transfer multiplexer of Claim 1 wherein the energy conversion system comprises a multiphase system including a plurality of input phases and a plurality of output phases and wherein said first plurality of energy transfer control elements corresponds to the plurality of input phases and said second plurality of energy transfer control elements corresponds to the plurality of output phases.

3. The energy transfer multiplexer of Claim 2 wherein each of said first plurality of energy transfer control elements comprises a switch coupled to the corresponding input phase and each of said second energy transfer control elements comprises a switch coupled to the corresponding output phase.

4. The energy transfer multiplexer of Claim 3 wherein said each input phase is shunted to ground by a corresponding shunt capacitor and each output phase is shunted to ground by a corresponding shunt capacitor.

5. The energy transfer multiplexer of Claim 1 wherein said resonant transfer link comprises a series connected resonant inductor and resonant capacitor.

6. The energy transfer multiplexer of Claim 1 further including an isolation element.

7. The energy transfer multiplexer of Claim 6 wherein said isolation element comprises a transformer coupled between said resonant transfer link and said second plurality of energy transfer control elements.

8. The energy transfer multiplexer of Claim 6 wherein said isolation element comprises a transformer coupled between said resonant transfer link and said first plurality of energy transfer control elements.

9. The energy transfer multiplexer of Claim 1 further including at least one ground energy transfer control element coupled between one side of said resonant transfer link and ground.

10. The energy transfer multiplexer of Claim 9 further including a first ground energy transfer control element coupled between one side of said resonant transfer link and ground and a second ground energy transfer control element coupled between the opposite side of said resonant transfer link and ground.

11. The energy transfer multiplexer of Claim 1 further including a plurality of sensors to monitor operating conditions of the signal processing to control the operation of said energy transfer multiplexer in response to the operating

conditions wherein said plurality of sensors is coupled between a logic section and said first plurality of control elements, said second plurality of control elements and said resonant transfer link to sense the voltage levels of each of said first plurality of control elements and each of said second plurality of control elements and the voltage level across said resonant transfer link and to generate voltage level signals corresponding to each voltage level and to feed the voltage levels signals corresponding to each voltage level to said logic section for processing and to generate control signals fed to said first and second plurality control elements to control the flow of energy between the energy source to the energy load.

12. The energy transfer multiplexer of Claim 11 wherein said entire signal processing and signal generation is time dependent.

13. The energy transfer multiplexer of Claim 11 further including a signal processing section comprising power/phase management section, a polarity management section, a voltage management section and a switch management section to receive operating voltage signals, compare the operating voltage signals with predetermined voltage references and generate control signals.

14. The energy transfer multiplexer of Claim 13 wherein the voltage for each said control element is sampled to determine whether or not potential for each input phase and for each output phase is within a predetermined voltage range of corresponding predetermined voltage reference level.

15. The energy transfer multiplexer of Claim 14 wherein the polarity of charge across said resonant capacitor is sensed by a polarity management section and corrected if necessary before energy is transferred through said resonant transfer link.

16. The energy transfer multiplexer of Claim 15 wherein the polarity of the charge on said resonant capacitor is corrected by substantially simultaneously coupling opposite sides of said resonant transfer link to ground by a first ground element and a second ground element respectively.

17. The energy transfer multiplexer of Claim 16 wherein the substantially simultaneous coupling is for substantially one-half cycle of the resonant frequency.

18. The energy transfer multiplexer of Claim 15 wherein said resonant capacitor coupled to ground through said first ground switch when said plurality of charge across said resonant capacitor is correct.

19. The energy transfer multiplexer of Claim 14 wherein said management section calculates and compares the final change V_{CF} on said resonant capacitor with a first predetermined voltage value and said first ground is coupled to E_O if the final charge V_{CF} is equal to or greater than said first predetermined voltage to prevent the voltage across said resonant capacitor from exceeding the breakdown voltage, and wherein, if the final charge V_{CF} is less than said first predetermined voltage, the initial charge V_{CS} on the resonant capacitor is compared to a second predetermined voltage value and then first local switch

is coupled to E_O if the initial charge V_{CS} is equal to or greater than the second predetermined voltage, if the initial charge V_{CS} is less than the second predetermined voltage, the sum of the input voltage E_I and the initial charge V_{CS} is compared to the output voltage E_O. If the sum of the input voltage E_I and initial charge V_{CS} is equal to or less than the output voltage E_O, then E_I is connected to G_O to increase the entire charge V_{CS}. If the sum of the input voltage E_I and initial charge V_{CS} is greater than the output voltage E_O, the E_I is connected to E_O.

20. The energy transfer multiplexer of Claim 14 wherein with the correct polarity across the resonant capacitor, when the V_{CF} is less than a predetermined multiple of E_{MAX} and V_{CS} is less than a predetermined multiple of E_O and the sum of E_I and V_C is greater than E_O, the poled input phase E_I supplies energy to the poled output phase E_O by closing the corresponding switches for the resonance wait or delay time.

21. The energy transfer multiplexer of Claim 20 wherein with the correct polarity across the resonant capacitor when the V_{CF} is less than a predetermined multiple of E_{MAX} and V_{CS} is less than a predetermined multiple of E_O and the sum of E_I and V_C is less than E_O, the poled input phase E_I is connected to G_O to increase the charge on the resonant capacitor.

22. The energy transfer multiplexer of Claim 1 wherein the electro-mechanical energy conversion system comprises an energy converter device coupled

between the energy source and the energy load to convert the energy from the energy source and to transfer the converted energy to the energy load.

23. The energy transfer multiplexer of Claim 22 wherein said energy converter device comprises an energy converter section including an induction machine having a wound rotor and stator to selectively convert the energy from the input energy source and to selectively transfer the converted energy to the output energy load and an energy transfer section including a plurality of stator control elements coupled to said stator and a plurality of rotor control elements to said rotor of said induction machine.

24. The energy transfer multiplexer of Claim 23 further including an energy conversion and transfer control to selectively control the energy converted from the input energy source and transferred to the output energy load in response to a plurality of predetermined conditions.

25. The energy transfer multiplexer of Claim 24 wherein said energy conversion and transfer control comprises an energy converter control to control the operation of said energy converter device and a source/load control to control the operation of said input energy source and output energy load with respect to said energy converter device.

26. The energy transfer multiplexer of Claim 22 further including an energy conversion and transfer control to selectively control the energy converted

from the input energy source and transferred to the output energy load in response to a plurality of predetermined conditions.

27. The energy transfer multiplexer of Claim 26 wherein said energy converter device comprises an energy converter section including an induction machine having a rotor and stator to selectively convert the energy from the input energy source and to selectively transfer the converted energy to the output energy load and an energy transfer section including a plurality of stator control elements coupled to said stator and a plurality of rotor control elements to said rotor of said induction machine, and wherein said energy conversion and transfer control comprises an energy converter control to control the operation of said energy converter device and a source/load control to control the operation of said input energy source and output energy load with respect to said energy converter device.

28. The energy transfer multiplexer of Claim 1 wherein said first plurality of energy transfer control elements comprise a plurality of switches each coupled to a separate input of the energy source by a corresponding conductor shunted to ground by a corresponding shunt capacitor and said second plurality of energy transfer control elements comprises a switch coupled to a separate input of the energy load by a corresponding conductor and shunted to ground by a corresponding shunt capacitor.

29. The energy transfer multiplexer of Claim 28 the bi-directional resonant transfer link comprises a series resonant inductor and resonant capacitor.

30. The energy transfer multiplexer of Claim 29 further includes a transformer coupled between said resonant transfer link and said second plurality of energy transfer control elements.

31. The energy transfer multiplexer of Claim 29 further includes a transformer coupled between said resonant transfer link and said first plurality of energy transfer control elements..

32. The energy transfer multiplexer of Claim 31 wherein the energy transfer device includes a first local ground energy transfer control element coupled or connected between one side of said resonant transfer link to ground and a second local ground energy transfer control element connected between the opposite side of said resonant transfer link and ground.

33. The energy transfer multiplexer of Claim 31 includes a plurality of operating parameters or condition sensors to sense and feed real time current and voltage values or data to the energy converter control of the energy conversion and transfer control.

34. The energy transfer multiplexer of Claim 3 wherein said input and output switches are programmed to operate as a charge pump to provide the high switch sample rates (time repetitive duration) to transfer charge at high power and high frequency and to a charge pump sequence to provide the required input to output voltage gain at the reduced PMG rotation rates.

35. The energy transfer multiplexer of Claim 3 wherein the input switches from each phase is energized in a timed pattern so that the phase AC input is

processed by charge transfer directly to a corresponding phase output thereby eliminating the rectification and DC link required with PWM conversion.

36. The energy transfer multiplexer of Claim 3 wherein the input and the desired charge transfer conditions to perform soft-start and rapid shut-down of current flow.

37. The energy transfer multiplexer of Claim 3 wherein the series resonant link provides electrical isolation at above and below the resonant link resonating frequency and whereby the control of the input switches and output switches are driven with a timing pattern and sequence to provide the volt-amps reactance (VARs) to the three phase load during the fault disturbance.

38. The energy transfer multiplexer of Claim 10 wherein said four input switches are time sequenced is a timing pattern to allow each phase of the generator to supply sinusoidal current at the desired generator power factor and sequencing the output switch to supply sinusoidal current at the power factor requested by the AC grid.